



Northeast Dry Bean Production Guide



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Introduction

Dry beans (*Phaseolus* spp.) come in a wide variety of shapes, colors, and sizes (Figure 1). Varieties like Jacob's cattle, European soldier, Black turtle, and Yellow-eyed beans are commonly grown in the Northeast. The edible field bean is considered a grain legume crop that is well-suited for our climate but requires good soil quality and diverse crop rotations. Beans are a staple food for much of the world due to their high protein content (generally 22-24%). They can serve as a great addition to a grain rotation and are a highly marketable crop. Dry beans are harvested once the shell and bean have matured and dried.



Figure 1. Raquel (top) and Vermont Cranberry (bottom) dry bean varieties.

Sourcing Quality Seed

There are many different types of dry beans, which are often classified by color. Generally, within each type, both bush (determinate) or trailing (indeterminate) varieties are available. Growers should carefully choose their dry bean varieties based on maturity, growth habit, and water requirements and buy certified, disease-resistant seed. White beans are often recommended for the northeast because they tolerate poorer-quality soils and have a shorter growing season than colored beans. However, their light-colored flesh can become stained in wet weather, especially in late summer.

To ensure desirable plant populations, high yields, and quality, it is important to purchase high quality seed with good germination (> 90%) that is free of weed seeds and seed-borne diseases. Buying 'Certified Seed' is your best bet for purchasing high quality seed. However, sourcing certified heirloom dry bean seed in quantities greater than a pound has proven to be a challenge. Much of the heirloom bean seed we have found thus far has not been 'Certified Seed'—rather it has been saved seed from growers or from businesses selling beans for food.

If the germination rate is not listed on the label, it is imperative to do a germination test. Dry bean seed is easily damaged and therefore seed quality is relatively short lived. It isn't advisable to purchase seed known to be over three years old. A simple germination test can easily be conducted. It's recommended to test each bean variety in duplicate. Start by soaking two paper towels in water and spreading twenty seeds over one half of it, then fold the other half over the seeds. Fold and roll it up like a burrito, place it in a clear plastic bag or airtight container to keep it from drying out, and store in the dark. Open up each test daily to see if any seeds have germinated; remove any sprouted seed from the test. Add more water if paper towels dry out, making sure the tests remain damp but not dripping wet, and at a least 70 degrees Fahrenheit.

Most seeds like to be warm, but not hot. Continue to check daily until you have concluded that all the viable seeds have germinated. If you haven't seen a new sprout for 7 days, the test is probably complete. Dry beans will generally germinate in three to four days. Count how many seeds are left to calculate percent germination. For example, if you had 2 seeds left out of the original 20, then the germination rate would be 90% ($20 - 2 = 18$; $18/20 = .90$). If you did the tests in duplicate, average the two tests to get the germination rate. Seeding rates should be adjusted to compensate for low germ seed.

It is also important that dry beans be free of seed-borne diseases. Anthracnose is the primary seed-borne disease identified in Vermont. Unfortunately, there isn't a simple 'do-it-yourself' test you can conduct to determine whether or not your seed is infected. However, the University of Vermont Plant Diagnostic Clinic can screen seeds for Anthracnose and other diseases. For instructions on submitting a sample to the Clinic, visit the website at: <http://pss.uvm.edu/pd/pdc/>.

Production and Management

Soil & Fertility

Dry beans prefer a well-drained soil with relatively good fertility. Avoid planting dry beans in a field that floods easily, is heavily compacted, or regularly develops a thick crust. As with any crop, before selecting fields in which to plant dry beans it's advisable to test the soil fertility first. Information on how to properly take and submit a soil test may be found at the University of Vermont's Agricultural and Environmental Testing Laboratory at: http://www.uvm.edu/pss/ag_testing/. The soil test report generated will provide information on the field's current fertility levels and recommendations for amendments that may be added to improve soil fertility for dry beans.

Dry beans grow best in nearly neutral soil, with a pH around 7.0. More acidic soils will require the addition of limestone, preferably dolomitic lime, to raise the pH. However, dry beans are sensitive to soil zinc levels, especially in soils where the pH is above 7.0. To amend soil zinc levels, add 10 lbs per acre of zinc sulfate into your starter fertilizer. Broadcasting zinc onto fields is not recommended but foliar applications may be used if applied when the plants are young, before flowering. Depending on your soil test results, nitrogen, phosphorus, and potassium (N-P-K) may need to be applied.

Beans are sensitive to salt injury and ammonia burn; therefore, fertilizer should be band applied and separated from the seed by 2 to 3 inches. Beans should not require any additional amendments after planting. Dry beans are legumes so they produce their own nitrogen through a symbiotic relationship with rhizobium bacteria. Over-applying chemical fertilizers or manure

may cause excessive vegetative growth, increase risk of disease, and/or slow down the natural rhizobium growth.

Seeding Rates

Dry beans come in a variety of different sizes. Since, there aren't as many seeds per pound in a large bean variety (eg., kidney) as there are in a smaller variety (eg., black), it takes more seed of a larger bean variety to get the same plant population as a smaller bean variety. Therefore, it is important to calibrate your planter for the type of bean before you plant. Beans can be planted with a corn planter fitted with bean cups appropriate for the seed size or using a corn planter with different size seed plates. As a general rule, adjust the planter to seed at about 60 lbs per acre; this should produce about 7 seeds per foot. You may need to adjust the settings depending on the variety and germination rate.

Planting

Dry beans are generally planted in early June, once soil temperatures are reliably 60°F or higher. Beans can easily be injured or killed by frost, so it is best to delay planting until any chance of frost has passed. Most dry bean varieties need 90 to 100 days to mature.

Before planting, seeds should be inoculated with the bacteria *Rhizobium phaseoli* for optimal nitrogen fixation.

Beans are usually planted about 1½ to 2½ inches deep and in 30-inch rows. Some growers plant in narrower rows to suppress weed growth, but this can increase the likelihood of disease in leaves and stems and make cultivation and harvesting more difficult.

Beans are sensitive to day-length; when there are enough hours of sunlight, the plants produce small white or light purple flowers that are self-pollinating. Indeterminate varieties of dry beans will continue to expend energy in vegetative development for a few weeks after they flower. Most dry bean growth will occur when temperatures are between 65°F and 75°F. During extended periods of cold (below 46°F) or hot (above 95°F) weather, beans may shed blossoms and developing pods. Because beans cannot tolerate water-logged soils and require adequate moisture as they bloom and develop pods, water management is often the most crucial issue with dry beans. Drier conditions during the season (or heavy rainfall near harvest) will decrease yields.

Dry Bean Pest Management

Weed Control

Weeds may develop quickly in beans because the beans are slow to establish a canopy and do not compete well. Pre-emergent weed control can be accomplished with either a tine-weeder or a rotary hoe, depending on the conditions and amount of plant residue in the field. Do not cultivate when the beans are starting to emerge as bean seedlings are very fragile and can easily snap. Cultivation can be undertaken when plants are between 2 and 3 inches tall until canopy closure. A word of caution: bean taproots are easily torn from the ground during imprecise mechanical cultivation. To minimize damage to plants, beans should not be cultivated when they are wet or just after they have flowered.

Diseases

Dry beans are susceptible to various root rots including *Rhizoctonia*, *Fusarium*, and *Pythium* –all can cause seedling death and reduce yields. In addition, several bacterial leaf diseases including Bacterial Bean Blight, Bacterial Brown Spot, and Halo Blight are common (Figures 2 and 3). Bacterial diseases are challenging to identify, but samples of diseased plant tissue can be sent to the UVM Plant Diagnostic Clinic for positive identification; see <http://pss.uvm.edu/pd/pdc/> for submission instructions.

Fungal pathogens include *Sclerotinia* white mold (Figure 4), and one of the most destructive diseases, Anthracnose. Anthracnose (Figure 5) begins with discoloration as red spots on leaves that develops into lesions. As lesions develop, leaf veins turned reddish-dark brown and spread



Figure 2. Bean leaf infected with Bacterial Bean Blight.



Figure 3. Dry bean plant infected with Bacterial Brown Spot.

through the leaf. The fungus then spreads to the pods, causing black lesions. Anthracnose can wipe out entire fields of bean and is spread primarily by planting infected seed.

In our cool, moist climate, practices that are critical to managing the multitude of diseases that impact dry beans include:

- planting clean seed,
- improving air flow and
- rotating crops.

Buying “certified” seed is highly recommended whenever possible. Certified seed guarantees that the seed meets or exceeds a strict set of quality control standards. In the case of beans, this includes rigid standards of seed diseases.

Weed management is especially important to improve air flow and assist with keeping the bean plant canopy as dry as possible. A dry canopy can help minimize the infection of disease. Spores from many of the fungal diseases can survive in the soil for 3 to 5 years, waiting for their host plant and/or ideal conditions.

Crop rotation is also critical to minimizing diseases present during bean production. Dry beans should not be grown in the same field for more than 1 to 2 years. Small grains are well-suited to rotations with beans because they are not susceptible to the same diseases as beans. Conversely, crops like sunflower, canola, and soybeans should be spaced properly between dry bean plantings.

Insect Pests



Figure 6. Potato Leafhopper nymph and adult.



Figure 4. White mold on dry bean plant.



Figure 5. Reddish, dark brown anthracnose in leaf veins and lesions on pod.

The primary insect pest of dry beans in the Northeast is the Potato Leafhopper, *Empoasca fabae* (Harris). Potato leafhoppers have an appetite for more than 200 broad leaf plants. Adult females overwinter in southern states and are carried northward on spring wind currents. The migratory nature of this native pest makes its arrival time and population size unpredictable.

Adults land in alfalfa and bean fields upon arrival where they feed and lay eggs. Potato leafhoppers are light green, wedge shaped insects that can be found scuttling on the underside of leaves. Adults are 1/8th of an inch long. Wings do not develop until the adult stage (Figure 6). Depending on spring arrival time and temperature, growers have witnessed 2 to 4 generations per season in the Northeast.

Potato leafhoppers feed with piercing-sucking mouthparts on host plant's vascular tissue. This restricts phloem and eventual xylem flow to the rest of the leaf resulting in leaf edge yellowing and curling. At high infestation levels, stunted internodes can be observed. Visual damage caused by potato leafhopper is called "hopperburn" (Figure 7). Hopperburn is not present until 5 to 7 days after leafhopper feeding has occurred. The first sign is yellowing of the leaf at the tip followed by necrosis and leaf curling. These symptoms are the result of the plant shutting down photosynthesis in the leaf in response to leafhopper feeding. As this pest weakens the plant, it becomes more vulnerable to disease.



Figure 7. Potato Leafhopper damage "hopper burn".

As with Integrated Pest Management (IPM) programs in other crops, weekly monitoring for pests is recommended. Scout the undersides of three leaves per plant in each variety is recommended weekly. Potato leafhoppers have feeding preference for particular varieties. Leafhoppers will steer clear of varieties that have leaves with more leaf hairs that exude chemical compounds. Preliminarily, Tiger's Eye appears to be a dry bean variety more susceptible to potato leafhopper. Insecticide options are limited for organic growers but products



Figure 8. Bean pullers, Morningstar Meadows Farm, Glover, VT.

with azadirachtin or pyrethrin as active ingredients are effective against potato leafhopper. For conventional management, products with active ingredients beta-cyfluthrin or imidicloprid may be used for potato leafhopper control. As always, pesticides used must be registered for use on dry beans in your state. Read and follow pesticide labels carefully. Certified organic producers should ensure products are allowed by checking with their certifier before they apply any product.

Harvesting & Storing

Generally dry beans take 60 to 90 days to mature in the Northeast, depending on the variety. Bush varieties (including navy, kidney, and dry red beans) will mature more evenly and facilitate consistent harvesting. When the majority of the pods have turned



Figure 9. Dry bean combine, Morningstar Meadows Farm, Glover, VT

yellow and dried down, beans are ready to be pulled and harvested. Harvesting can be difficult if the crop is weedy or not consistently ripe, and some field loss can occur during harvesting. Utilize the moisture in the early morning dew to minimize shattering. Because bean pods tend to lie close to the ground, most varieties need to be pulled either with a bean-puller (Figure 8). Or, if weedy, by hand. A mechanized puller-cutter will uproot or cut the entire plant and lay it on the ground in windrows as the machine moves along the field, but a puller followed by a separate tow-behind windrower will accomplish the same goal. Combine these windrows when the beans have dried to 18% moisture and adjust the spike-tooth combine's two cylinders for low speeds (150 to 200 RPM's) to minimize shattering; monitor continuously for seed damage while harvesting (Figure 9). A portable bean thresher can be used to harvest beans that are hand-pulled (Figure 10).

Each bean pod typically has 6 to 8 seeds, and good dry bean yields are about 1500 to 1800 lbs per acre (with a test weight of 60 lbs per bushel), but this is heavily dependent on variety.

Clean beans to remove broken seed, stones, weed seeds, and other debris, but beware that excessive handling will lead to damage to seed coats. Many growers use a conveyor table to grade beans; any that are split, cracked, or otherwise broken and not up to human consumption standards can be roasted and incorporated into livestock rations. Beans should be conditioned using a low temperature and dried to a moisture level of 15-16%, then stored in bins that are inaccessible to rodents, insects, contamination, and temperature extremes. Storing dry beans at low temperatures (35 to 55°F) will discourage mold growth. Field beans can be marketed as dry beans or processed and sold as pre-cooked, canned beans for customer convenience.



Figure 10. Portable bean thresher, Morningstar Meadows Farm, Glover, VT.

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